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EFFECT OF TEMPERATURE ON THE SETTING PROPERTIES OF PRESTRESSED CABLE GROUT

MATERIALS INFORMATION
ENGINEERING MATERIALS OFFICE

EFFECT OF TEMPERATURE ON THE SETTING PROPERTIES OF PRESTRESSED CABLE GROUT

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Introduction

In November 1982, the Highway Standards Section proposed that the minimum concrete temperature requirement of Form 910.07.04.01 be changed from + 5°C at time of grouting the cable ducts, to + 10°C. There was concern that the grout would not gain sufficient strength at the specified temperature of + 5°C within 72 hours to withstand a temperature drop after this period. It was agreed at this time with O.R.B.A. that the Ministry would conduct laboratory tests to determine the effects of various drops in temperature on the strength of cable grout after 72 hours.

Mix Design

The grout mix was made in accordance with 910.07.04.03. The amount of mix was reduced from the prescribed quantities to accommodate the size of the Hobart laboratory mixer. Nine cubes were made from each batch.

910.07.04.03	laboratory proportions
1 - 40 kg bag type 30 cement (High Early)	2200 g
0.11 kg type W.R. non chloride admixture (Powder)	6.05 g
2 g fine aluminum powder	0.15 g

0.55 max. water cement ratio

Tests Performed

1) Viscosity
2) Expansion
3) Bleeding
4) Compressive Strength

Tests 1, 2 and 3 met the requirements of Form 910. Compressive strength results are noted in Table #1.

Discussion

Grout Mix #1

Grout with a mix temperature of + 15°C was cast into 27 cubes. Nine of the cubes were cured for 3 days at + 5°C, nine at + 10°C and nine at + 20°C. Nine cubes were then tested in compression and the remainder were stored at - 15°C for an additional 4 days, after which nine more cubes were tested. The remaining cubes were stored in laboratory air for 21 days and then tested for compressive strength. The results are listed in Table #1.

Grout Mix #2

The procedure for grout mix #2 was similar to #1, except that the mix temperature was + 25°C. The results are listed in Table #1.

As shown in the compressive strength summary, the laboratory specimens were all subjected to a fall in temperature to - 15°C after the initial 3 day cure at temperatures ranging from + 5°C to + 20°C.

This temperature drop is greater than is likely to occur in field conditions.

Conclusions and Recommendations

The compressive strength summary indicates that there is very little difference in strength between the specimens that were cured for the first three days at + 5°C and those at + 10°C. We therefore recommend that the min. concrete deck temperature requirements in 910.07.04.01 remain at + 5°C.

TABLE #1

AVERAGE COMPRESSIVE STRENGTH OF CUBES

GROUT MIX TEMPERATURE 15°C

SET I — Cubes Cured For 3 Days

@ 5°C	@ 10°C	@ 20°C
13 MPa	11.6 MPa	21.6 MPa

SET II — Cubes Cured For 3 Days As In Set I Plus Additional 4 Days At - 15°C

18.2 MPa	16.5 MPa	27.4 MPa

SET III — Cubes Cured As In Sets I And II Plus Additional 21 Days In Laboratory Air

30.2 MPA	27.3 MPa	33.4 MPa

GROUT MIX TEMPERATURE 25°C

SET IV — Cubes Cured For 3 Days

@ 5°C	@ 10°C	@ 20°C
10.1 MPa	14.2 MPa	23 MPa

SET V — Cubes Cured For 3 Days As In Set IV Plus Additional 4 Days At - 15°C

19.7 MPa	14.2 MPa	29 MPa

SET VI — Cubes Cured As In Set IV And V Plus Additional 21 Days In Laboratory Air

28.7 MPa	28.2 MPa	36.5 MPa